

# Acute health effects of air pollution characterized by PM10, PM2.5, PM1.0, number and active surface of particles

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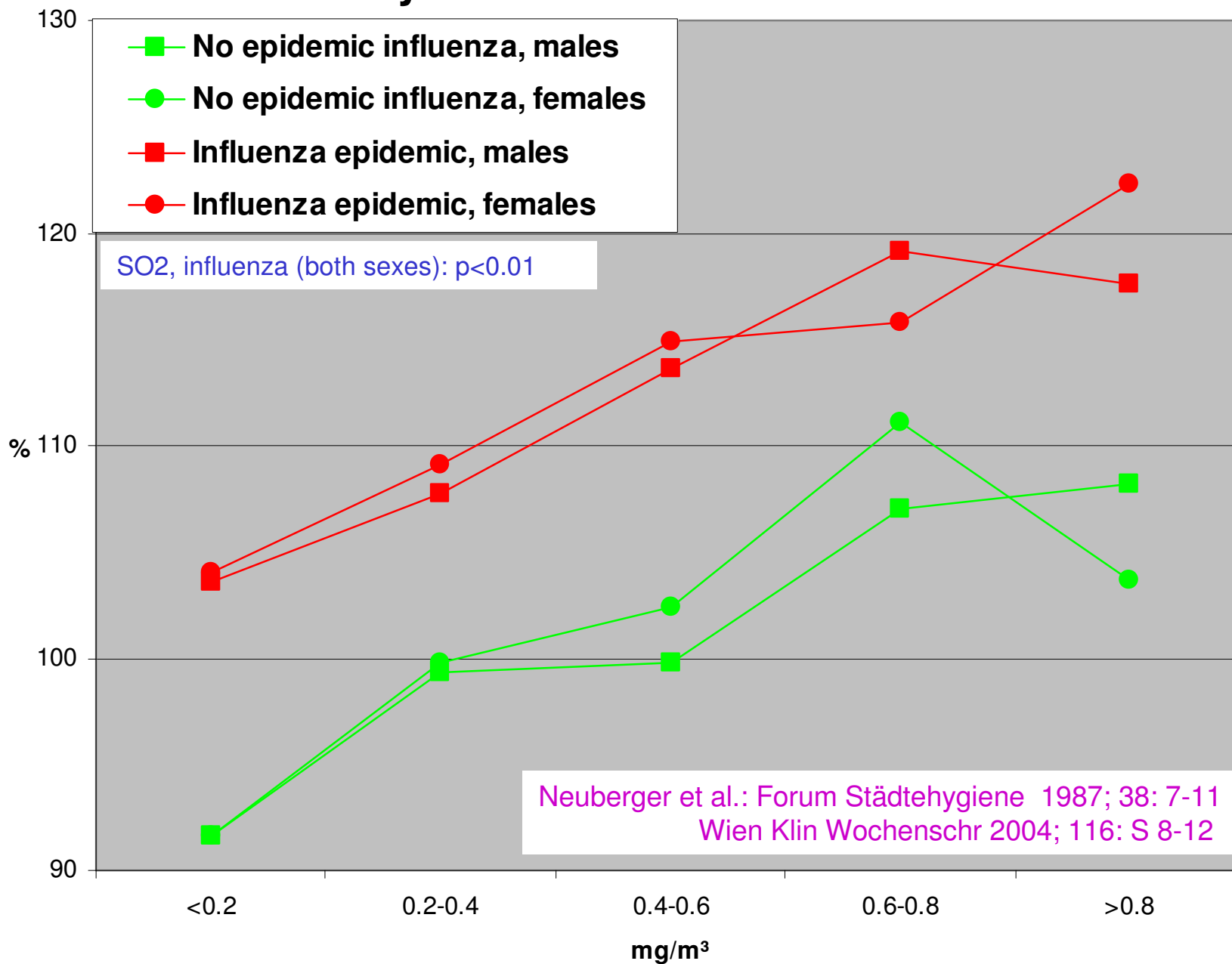
<sup>2</sup>Clean Air Commission



AUSTRIAN  
ACADEMY  
OF SCIENCE

# Daily mortality (SMR) in Vienna 1972-83 of persons at age 70+ yrs

## Total mortality



**AUPHEP** daily time series on  $PM_{10}$ ,  $PM_{2.5}$ ,  $PM_1$ , gases, meteorology and health



Linz



AUPHEP-3



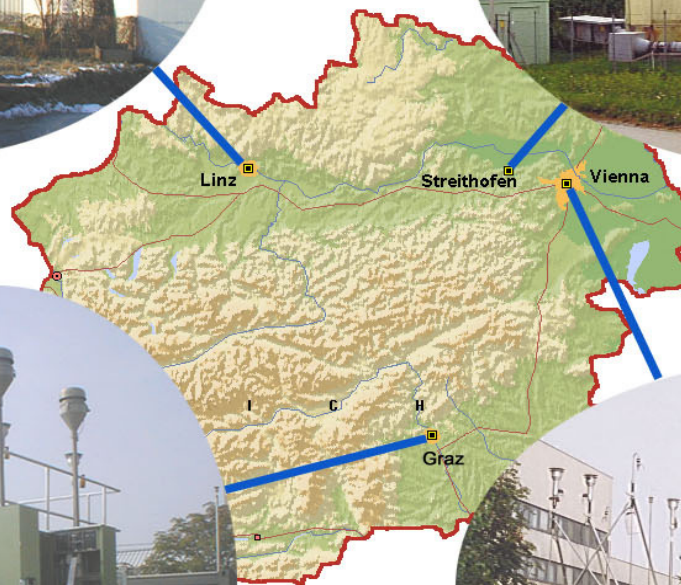
AUPHEP-2

Streithofen



AUPHEP-4

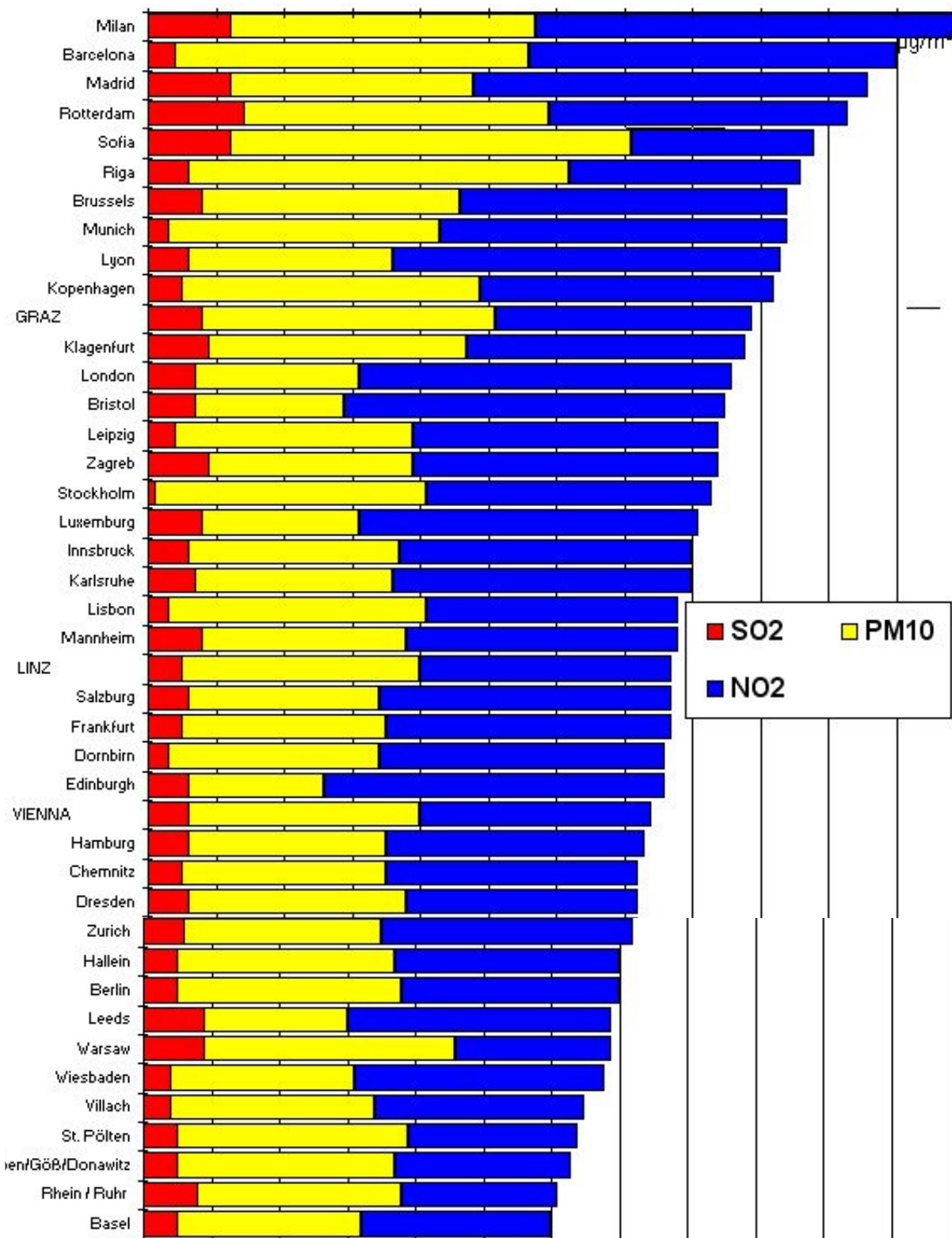
Graz



AUPHEP-1

Vienna

# Ambient air pollution in European cities 2003 annual area mean ( $\mu\text{g}/\text{m}^3$ )



Vienna during AUPHEP study:

	mean	median	95 p.
SO <sub>2</sub>	5	4	12
NO <sub>2</sub>	31	30	55
PM <sub>2.5</sub>	16	14	36
PM <sub>10</sub>	30	26	67

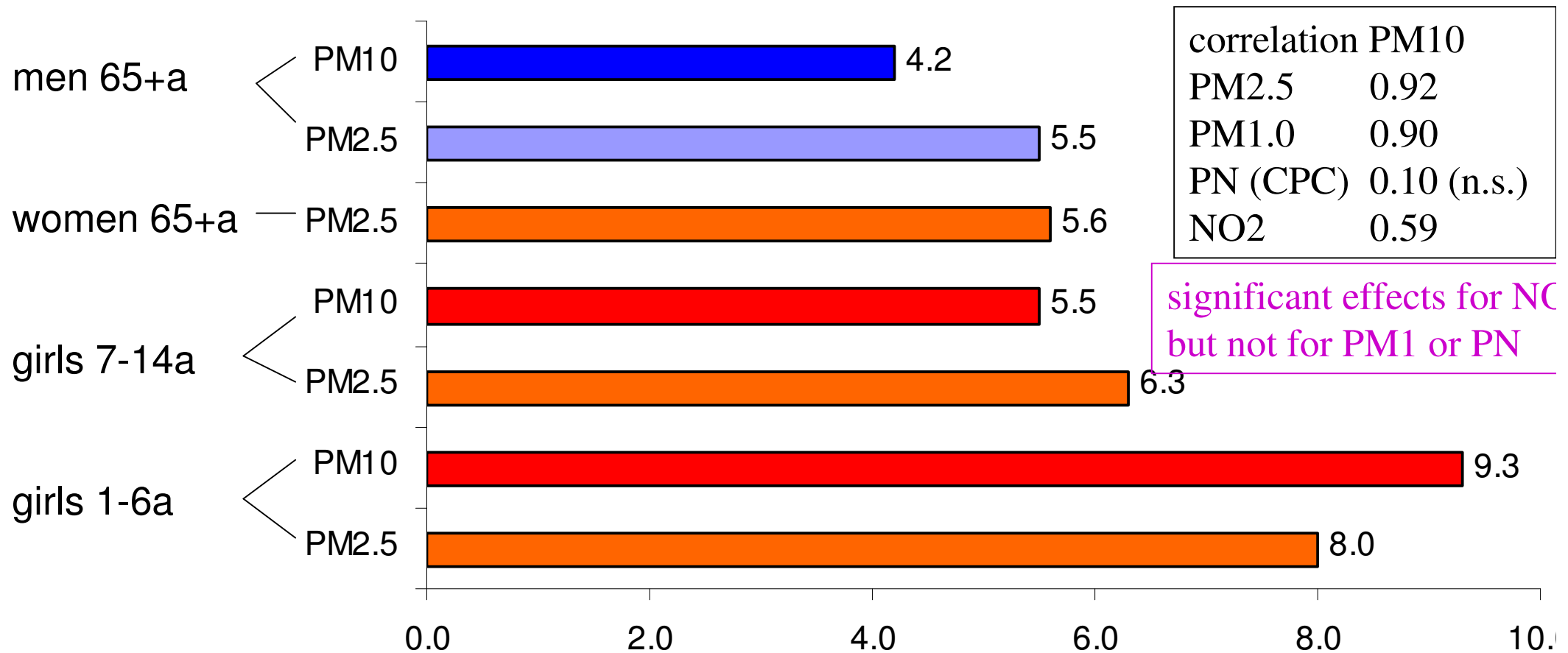
PM<sub>10</sub> >50 $\mu\text{g}/\text{m}^3$  on 15 days

acceptable: 35 days

(2005-2009: 30 days)

# ↑ Respiratory hospital admissions (ICD-9: 490-496) in Vienna at age 65+ yrs with daily PM – concentrations 1999-2000

semiparametric gam.exact 14-day lag model considering temperature, humidity, NO<sub>2</sub>, week-day dummy, epidemic influenza registered by sentinels.



Neuberger et al. 2004:  
Atmos Environ 38, 3971-81

% increase per 10 µg/m<sup>3</sup>

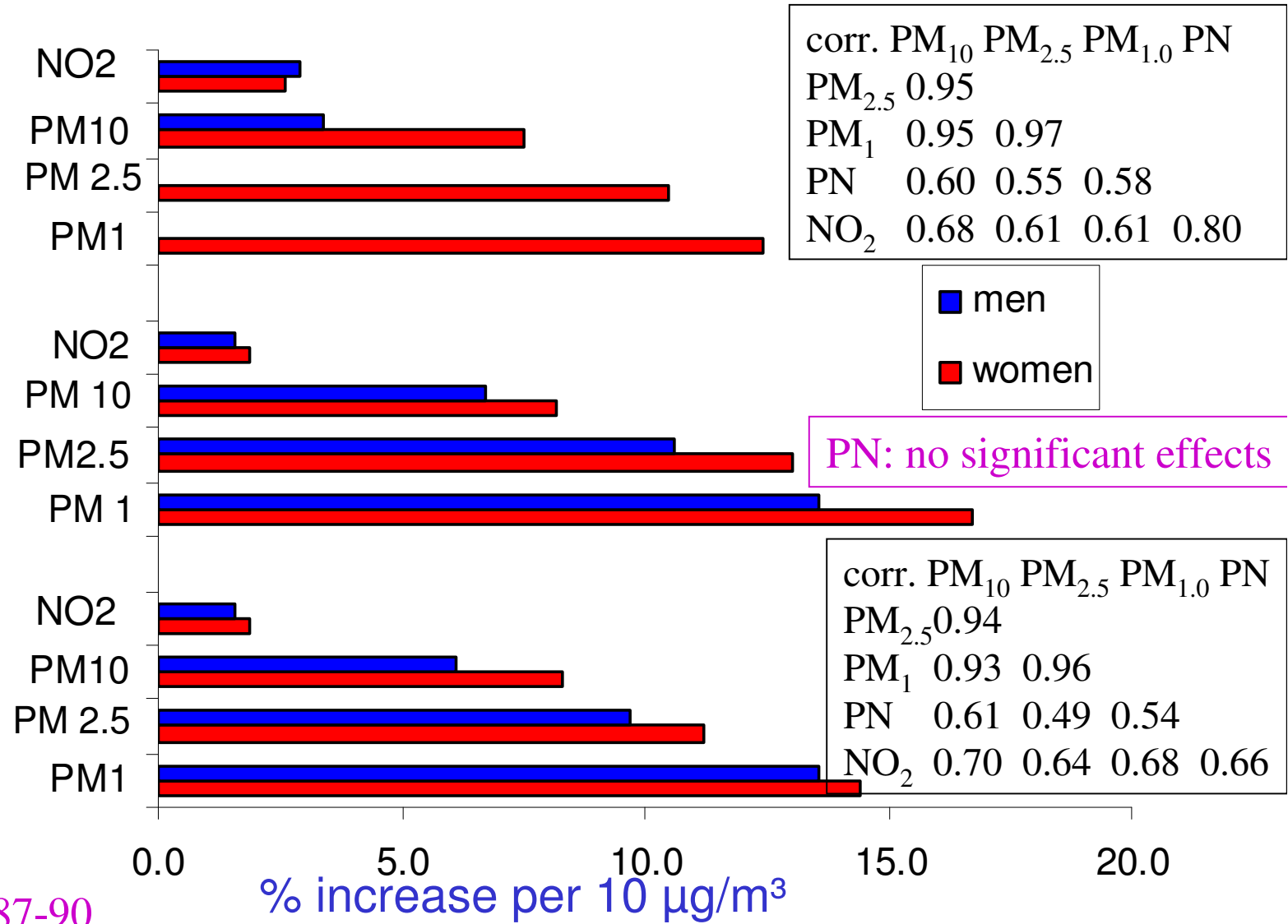
# ↑ Cardiovascular hospital admissions (ICD 410-438) with daily PM and NO2 concentrations 2000-2001

semiparametric Poisson GAMs (best fit selected from all models for lags 0 up to 14 days),  
significant associations for PM, PN, NO2, SO2, H2S, time, mean temperature, rel.humidity

**GRAZ**  
lag 0 days for NO2  
6 days for PM

**LINZ**  
lag 2 days for NO2  
6 days for PM

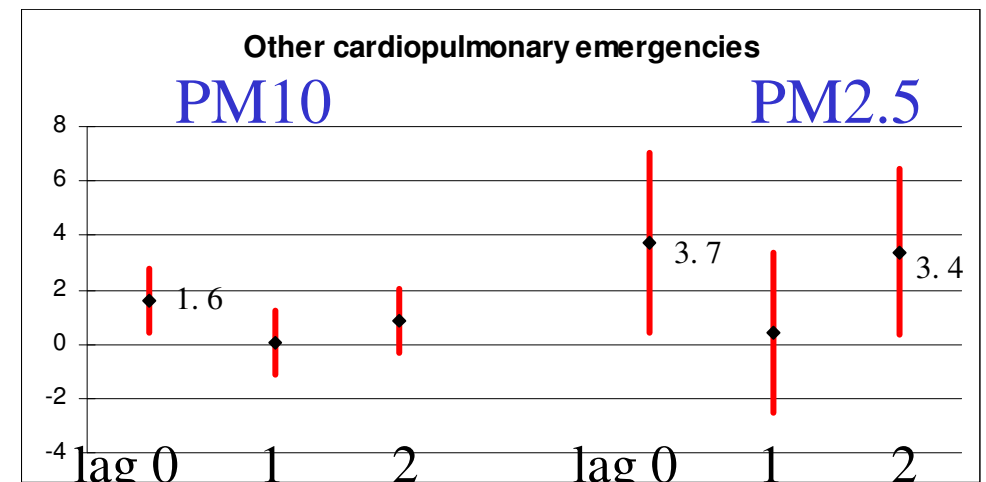
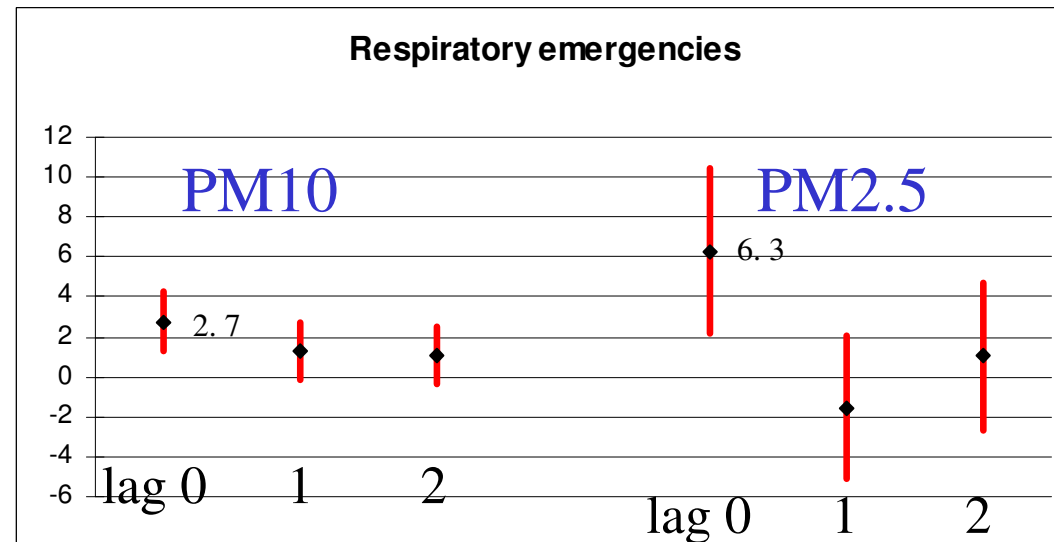
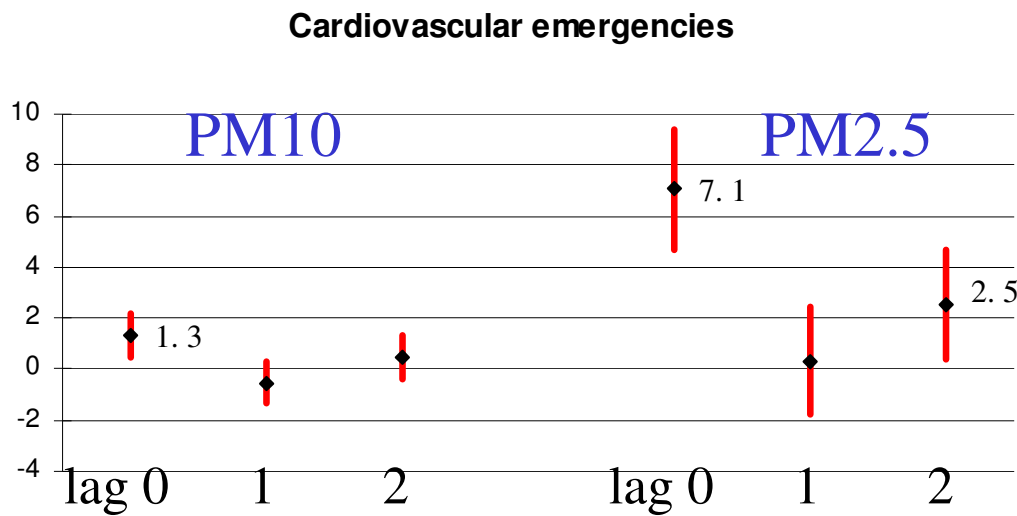
**LINZ lag 0 days**



# Emergency cardiopulmonary transports in Linz 2000-2007

% increase per  $10 \mu\text{g}/\text{m}^3$

case – referent (days with same **temperature**  
7 – 21 days before and after)



**Akaike's information criterion:** minimum degrees of freedom with maximum adjustment for confounders: meteorology (temperature, rel. humidity, air pressure and their change), weekday, month, long term trend.

Neuberger et al. 2009 unpublished

**Correlation between lung function (measured at 8 - 11 a.m.) of 164 healthy children of elementary school nearest to air monitoring station and active particle (“Fuchs”) surface (mean 0 - 8 a.m.) monitored by diffusion charging (LQ 1-DC) of ~ PM0.01-1.0**



FVC	FEV <sub>1</sub>	PEF	MEF <sub>75</sub>	MEF <sub>50</sub>	MEF <sub>25</sub>
-0.18**	-0.21**	-0.09	-0.10	-0.17*	-0.09

Pearson' correlation coefficients, significance (2-sided): p<0.01\*\*, <0.05\*



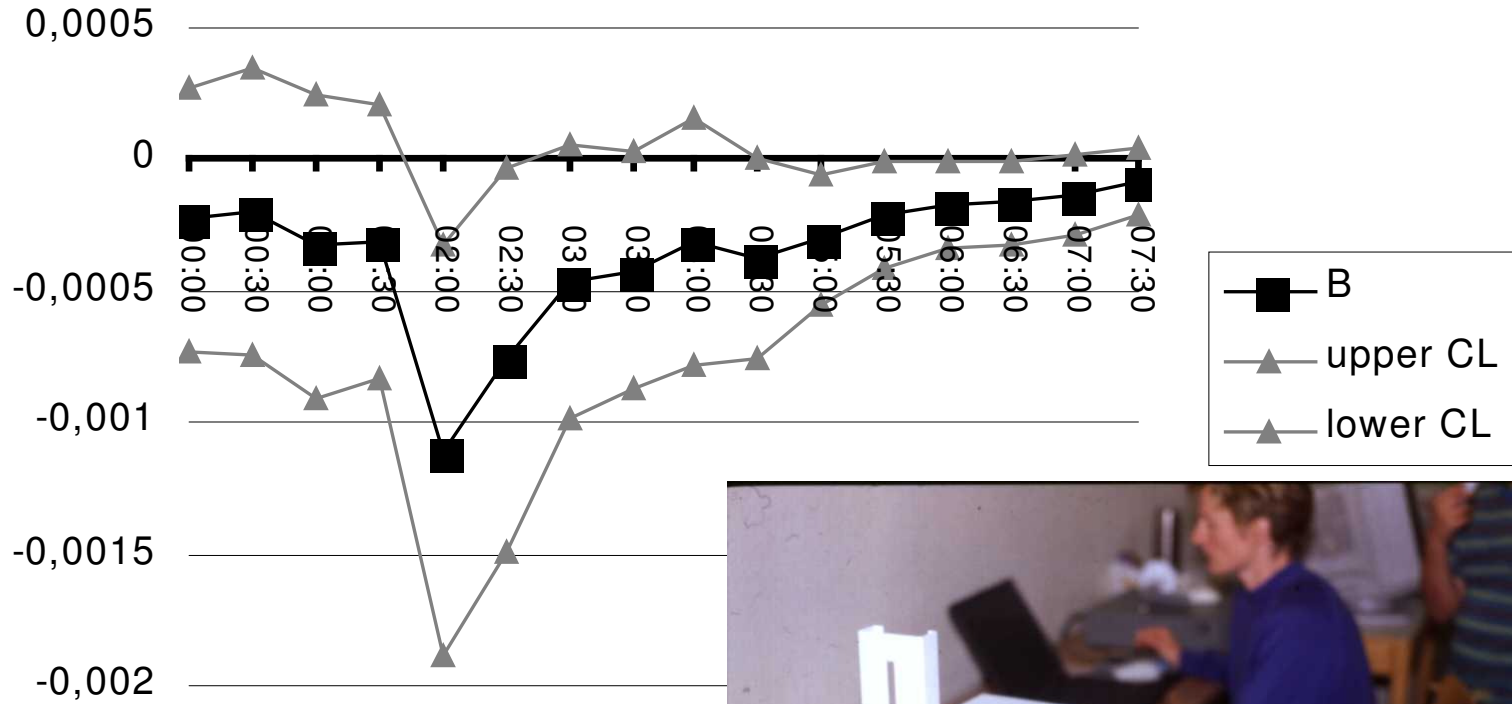
Linz steel plant

elementary school

# Short latency of particle surface effect on lung functions of elementary school children

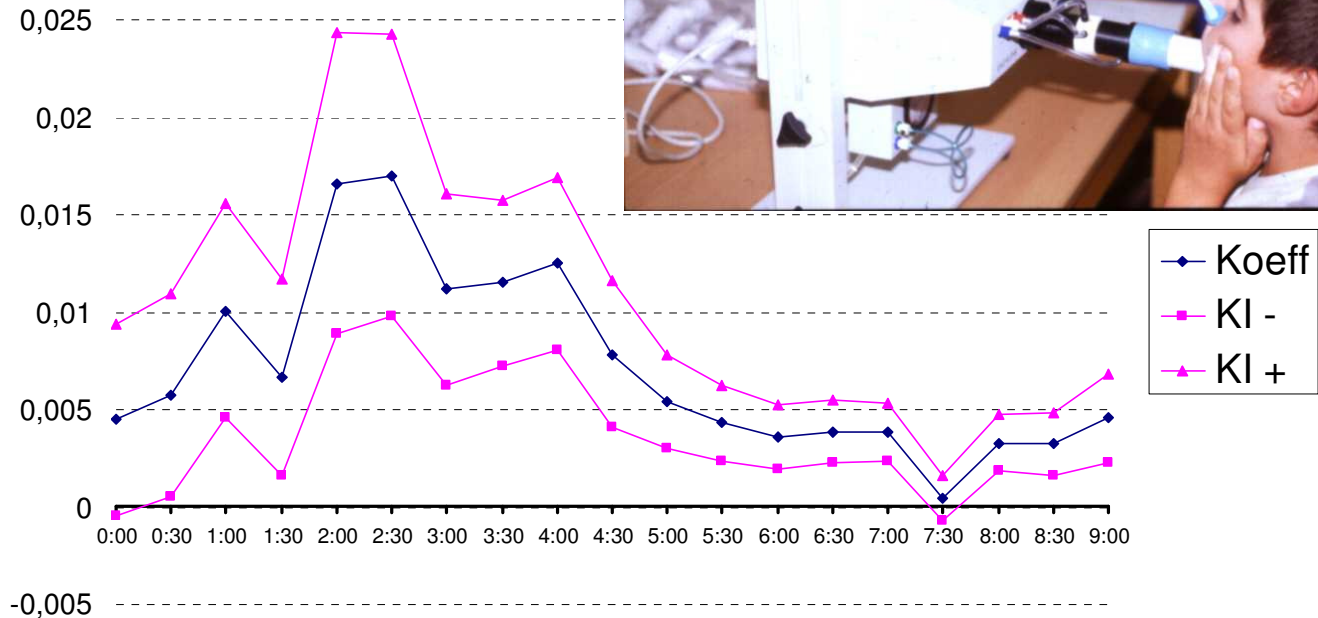
Coefficients (B) and their 95% confidence intervals of linear regression of lung function and active particle surface measured in half hour intervals

**FEV<sub>1.0</sub>**



**Resistance (0 Hz)**

linear regression of Zrs (4-16 Hz) to 0 Hz



**Asthmoid symptoms** in 94 children selected from 9 elementary schools surrounding the monitoring station because of poor lung function in past school year

Rank correlation between daily symptom score and particle **surface**

wheezing	dyspnea	cough			
		morning	day	evening	night
0.51**	0.33*	0.12	0.20	0.35*	0.38*

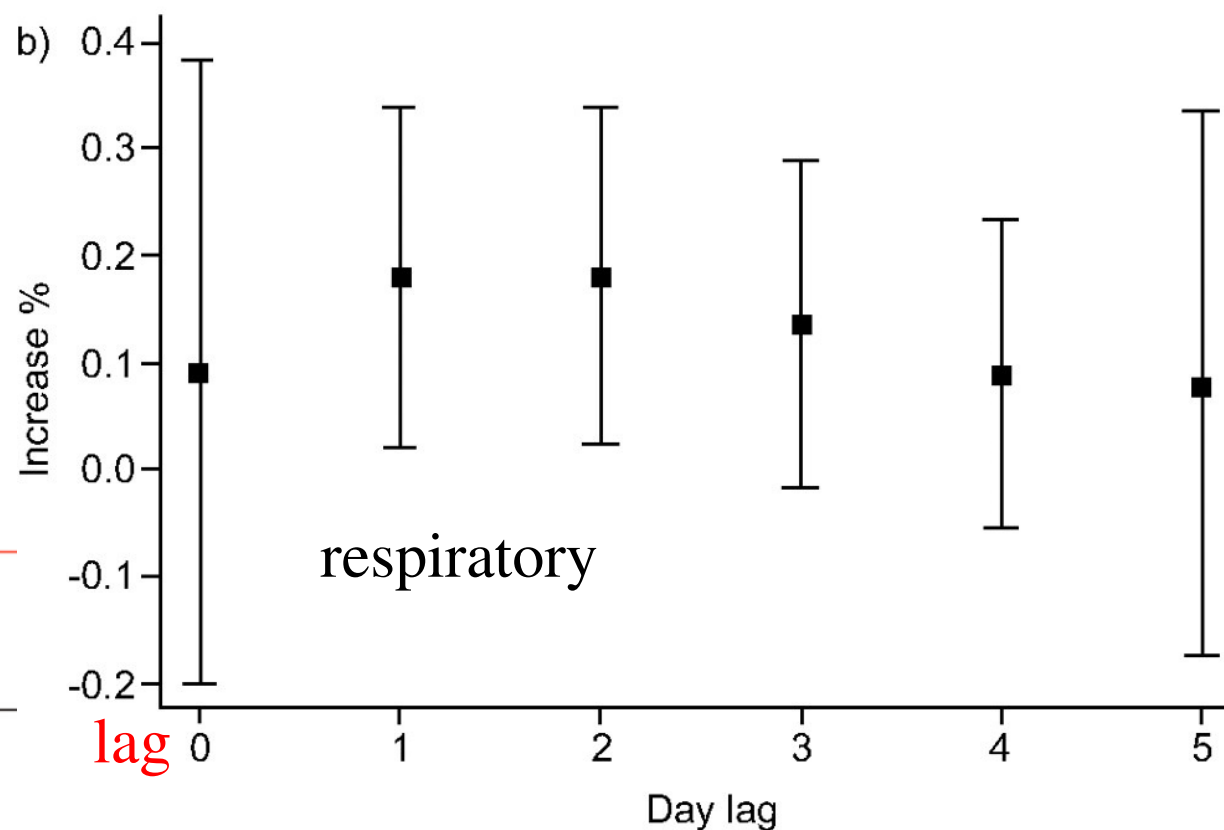
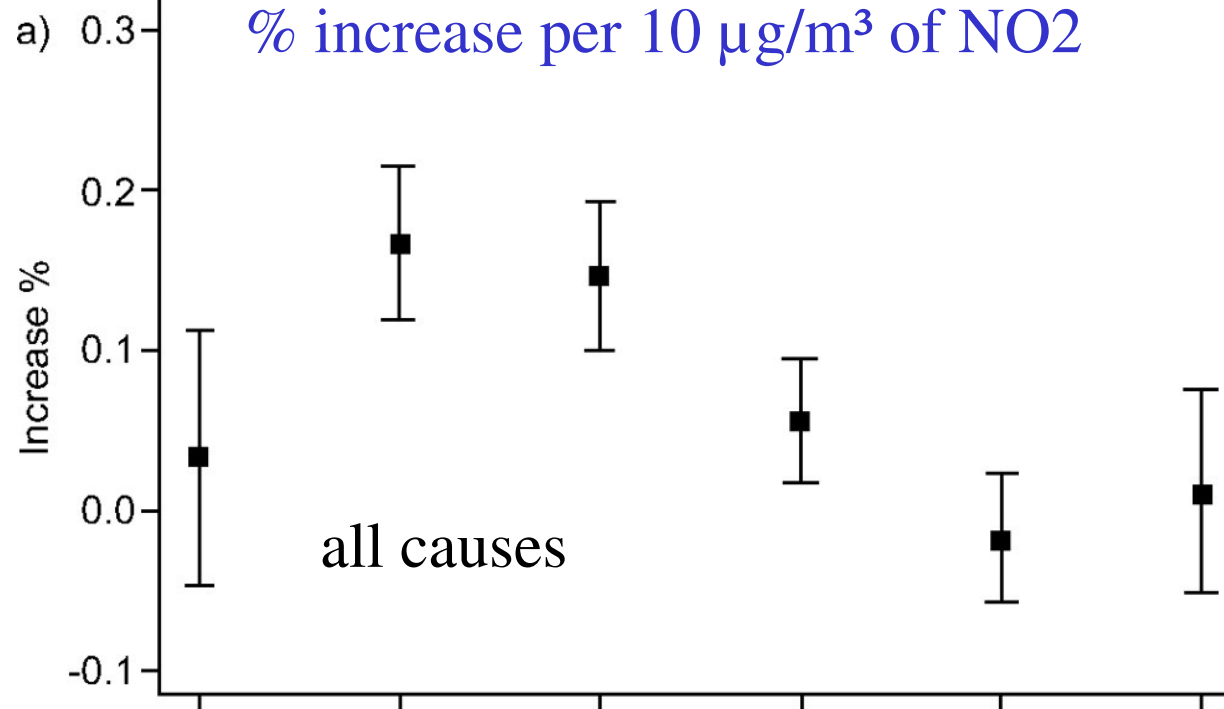
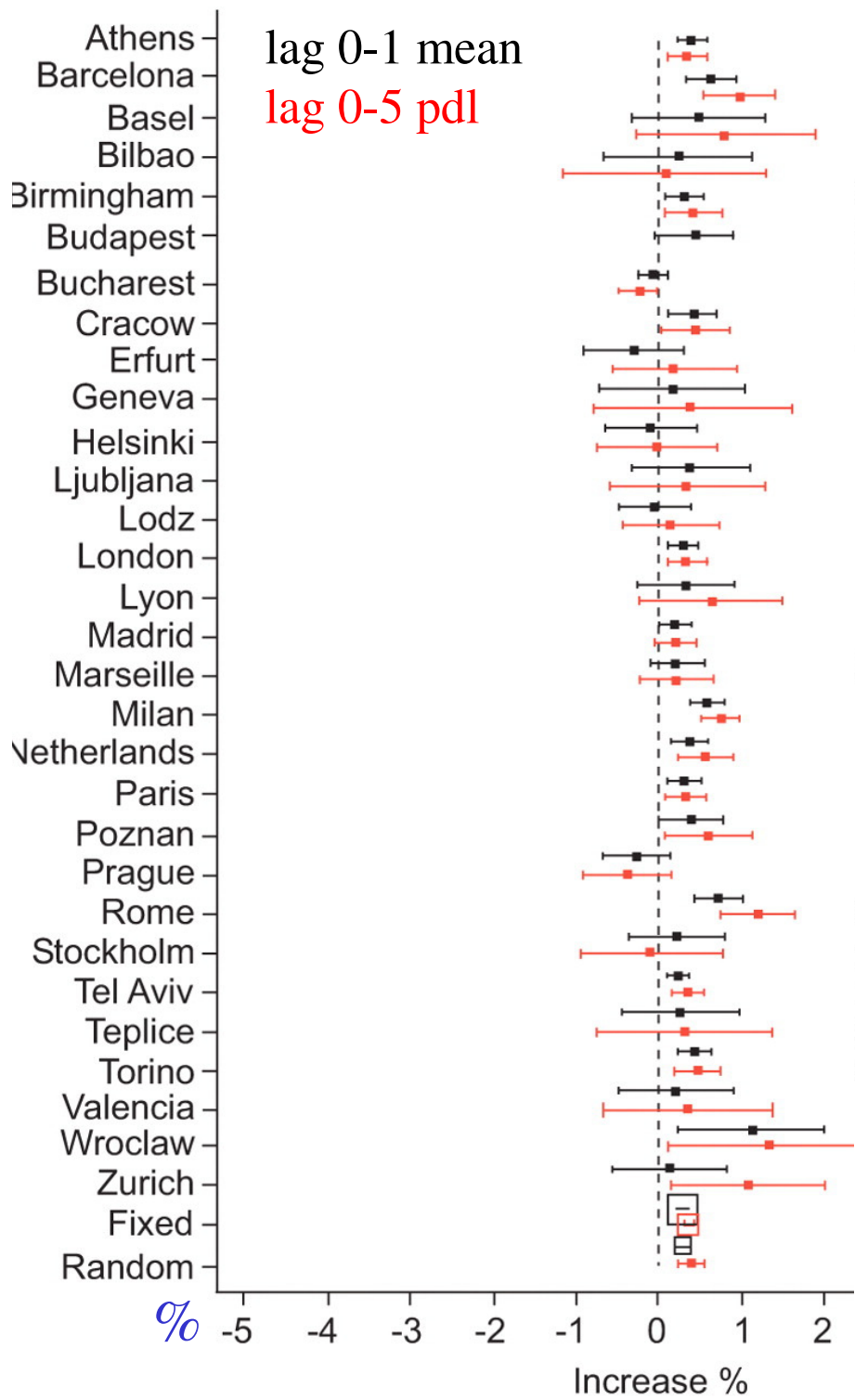
Atmospheric Environment 37: 1737-1744

Correlation of particle surface with other exposure indicators:

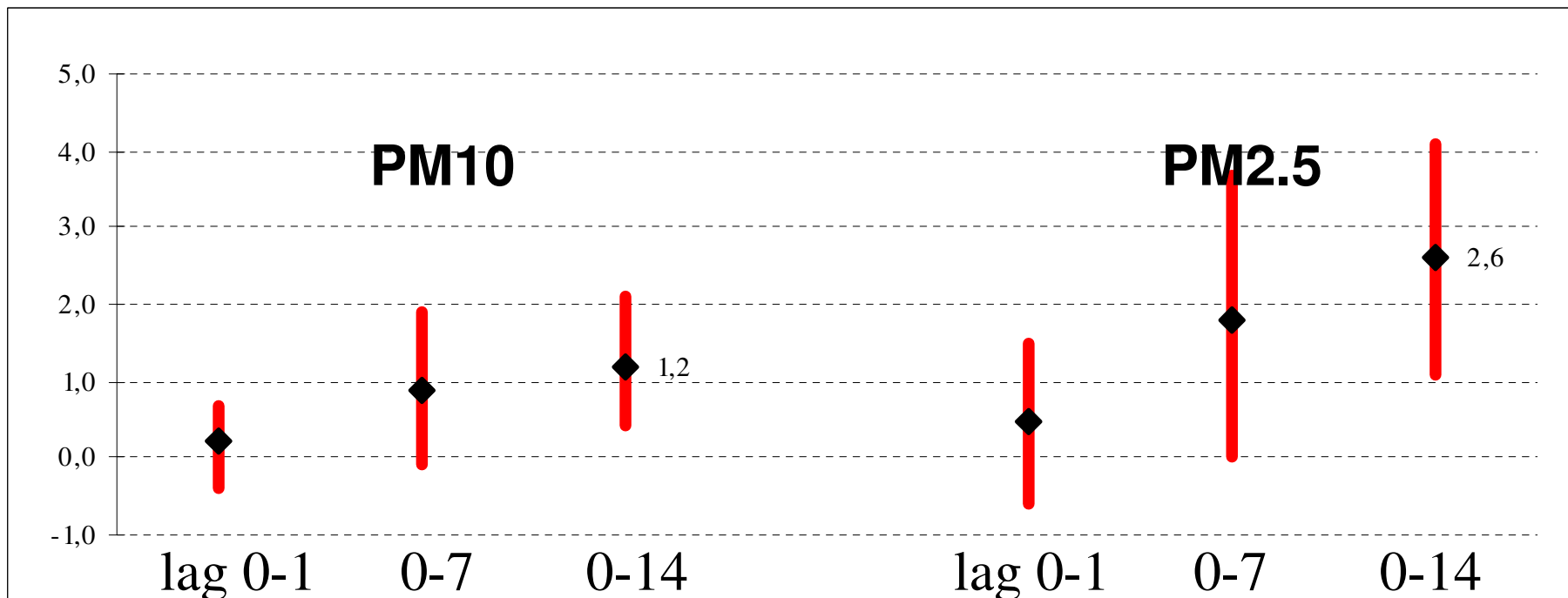
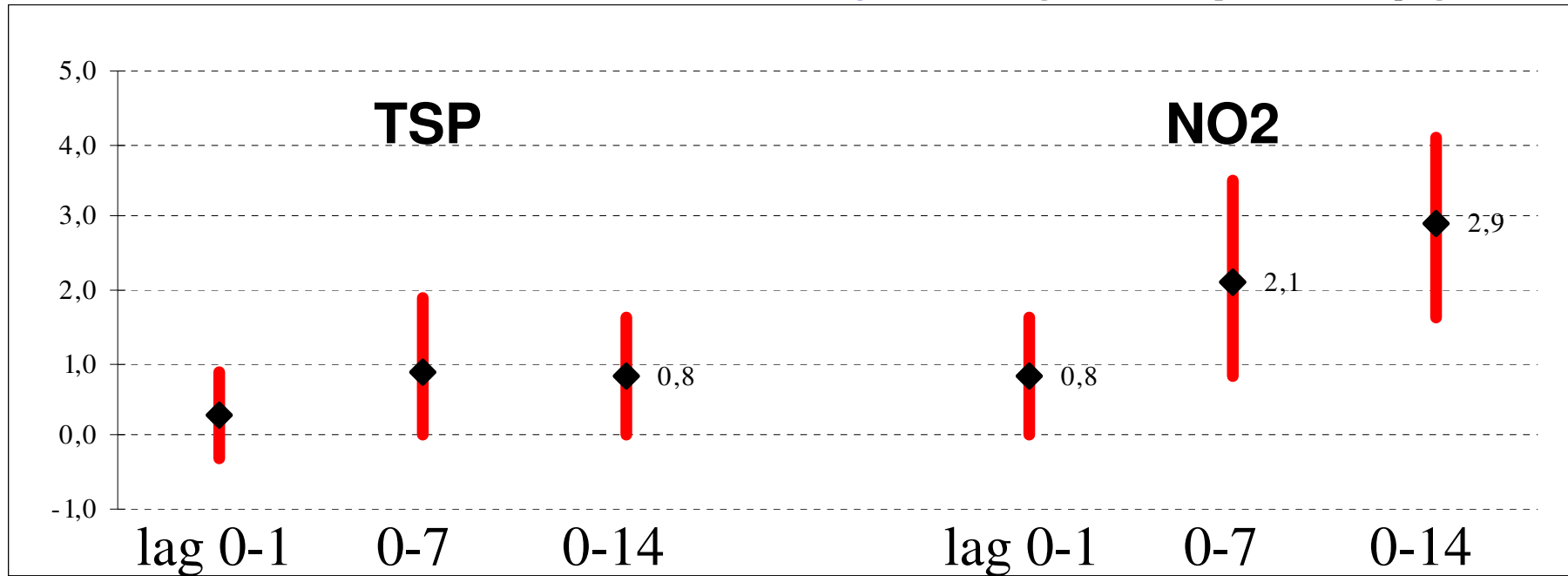
	gases			particle number	particle mass		
surface	O <sub>3</sub>	SO <sub>2</sub>	NO <sub>2</sub>	CPC	PM <sub>1</sub>	PM <sub>2.5</sub>	PM <sub>10</sub>
„Fuchs“	-0.19	0.15	0.49**	0.33*	0.38*	0.27	0.3
PAH	-0.28	-0.02	0.29	0.08	-0.09	-0.09	-0.04

photoemissions from particle-bound PAH in UV-light not associated with health and not associated with other pollutants.

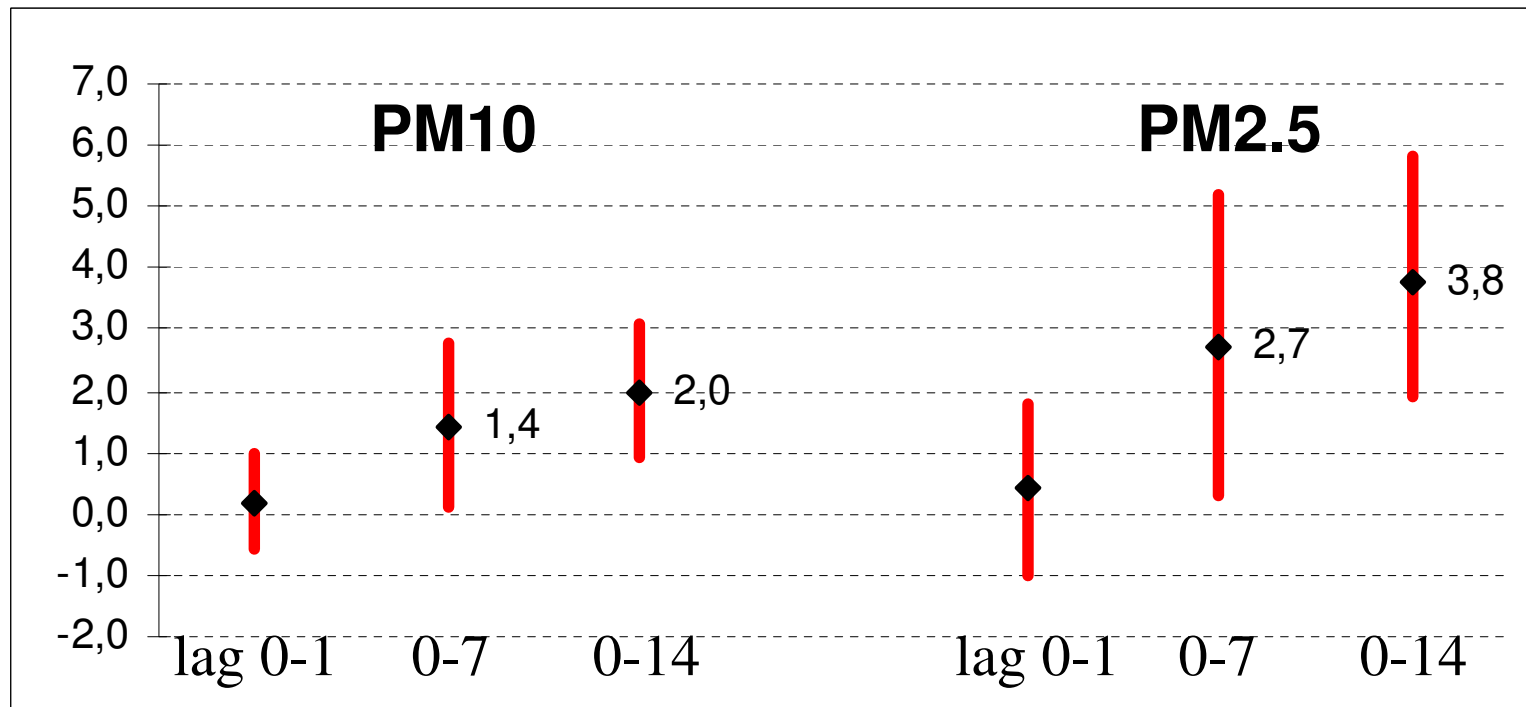
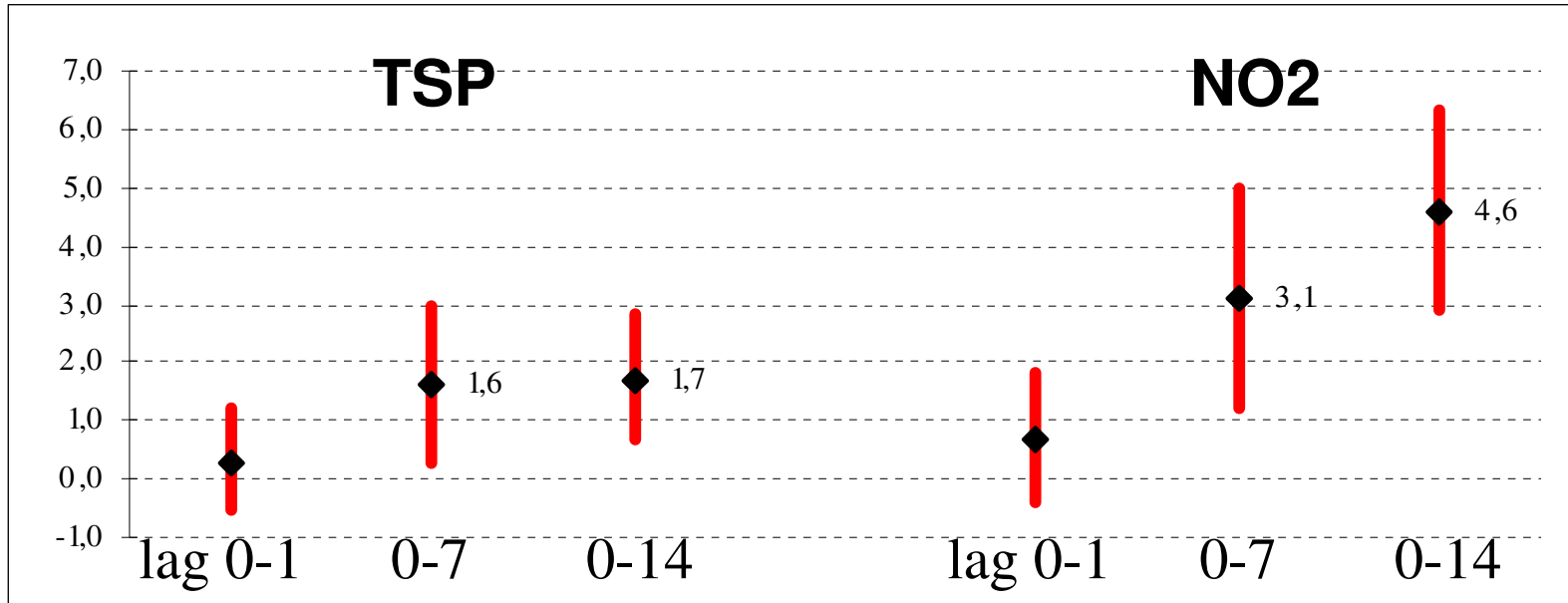
Aphea (Samoli et al.2006): **Mortality**



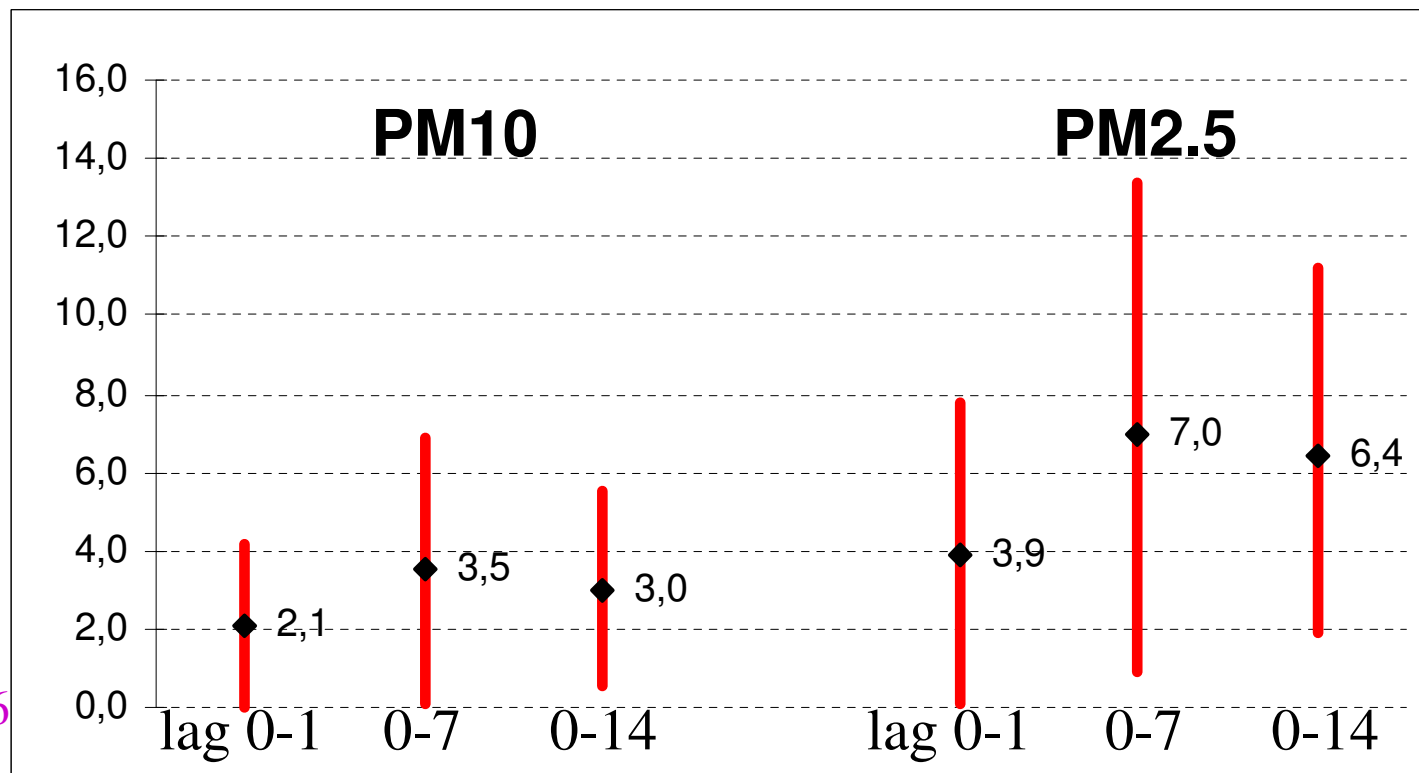
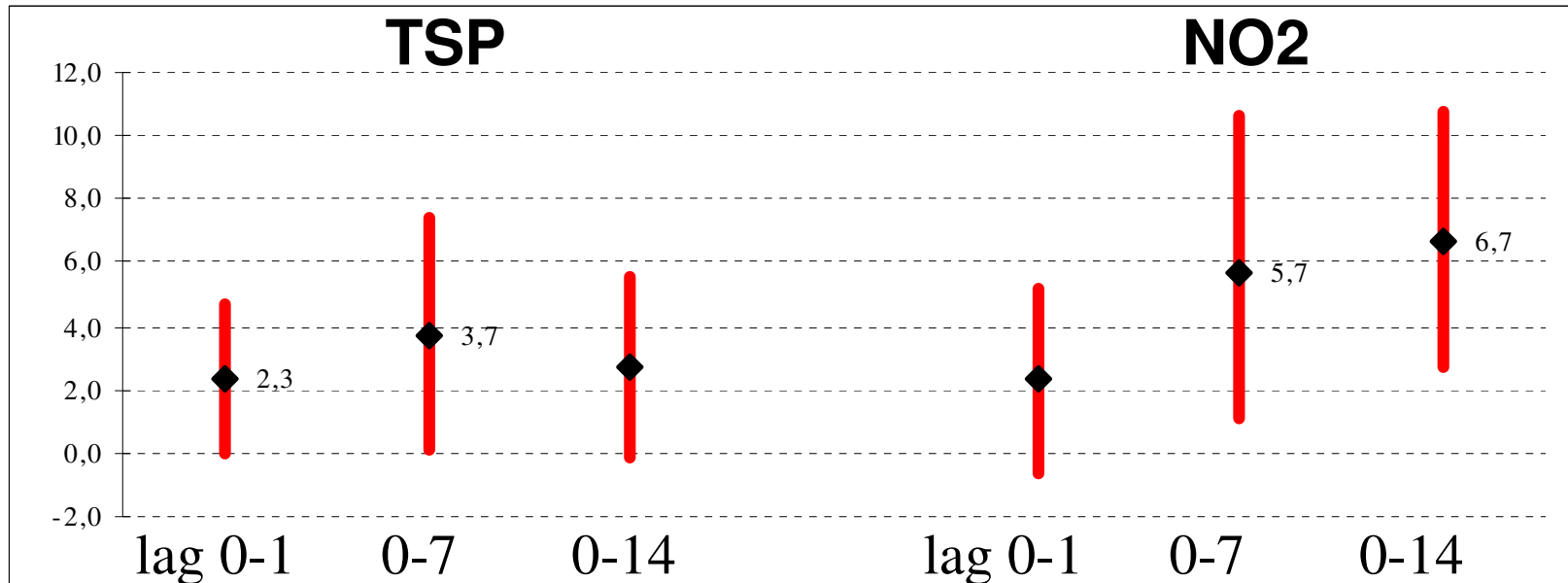
# Vienna 2000-2004: Total mortality change (%) per 10 $\mu\text{g}/\text{m}^3$ of



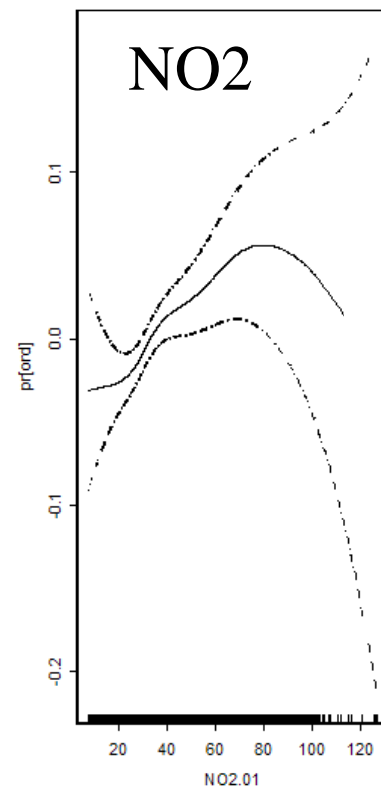
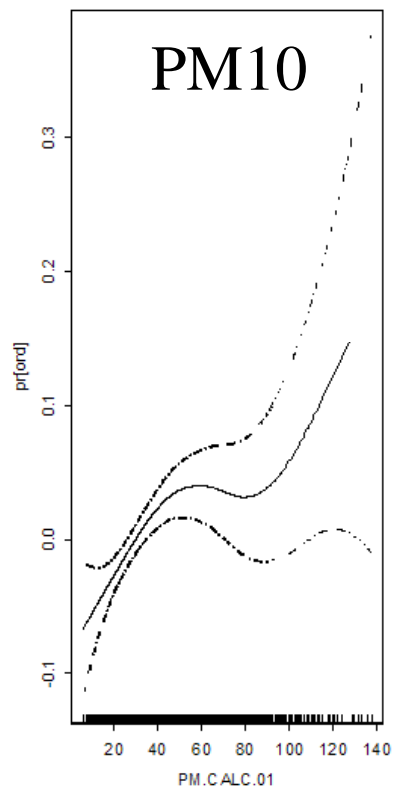
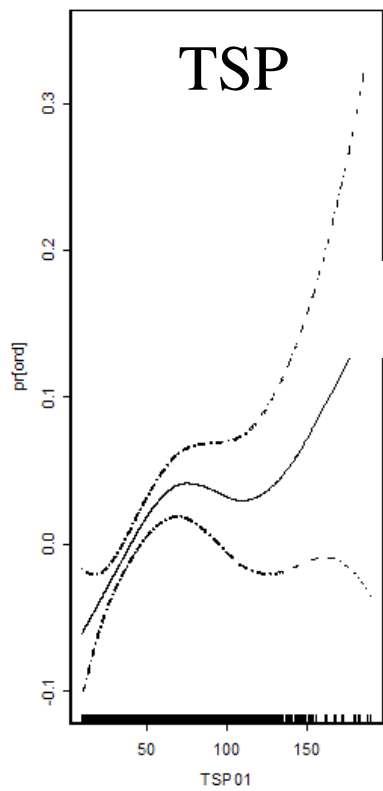
# Vienna 2000-2004: Cardiovascular mortality change (%) per 10 $\mu\text{g}/\text{m}^3$



# Vienna 2000-2004: Respiratory mortality change (%) per 10 $\mu\text{g}/\text{m}^3$ of



Neuberger et al.  
Atmos Environ  
41(2007):8549-56

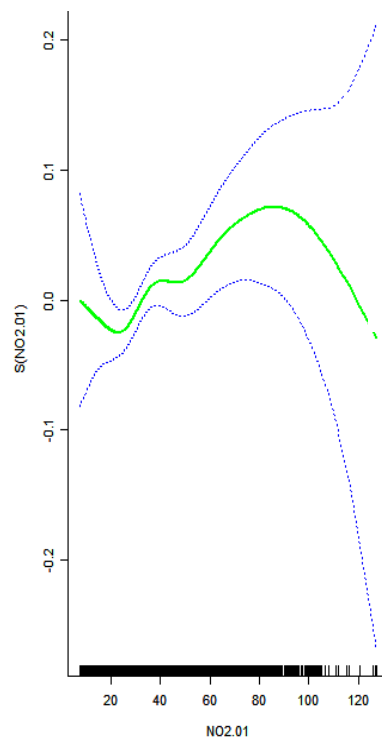
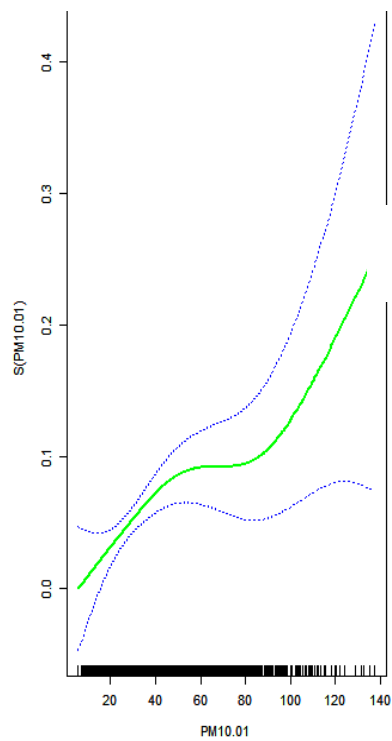
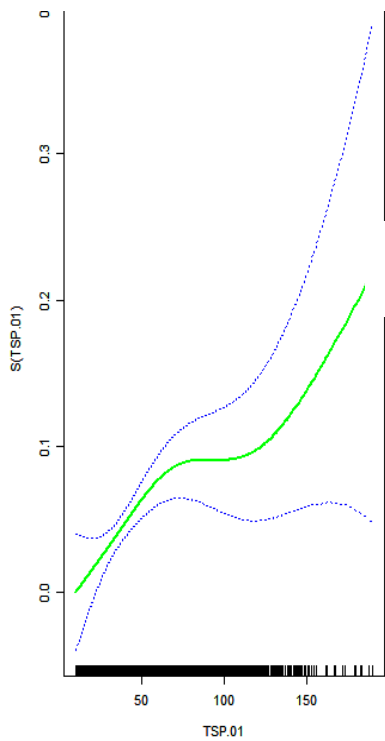


Acute increase of daily mortality  
(Graz 1990-2005)

lag 0-1 day, all causes

← adjusted for meteorology

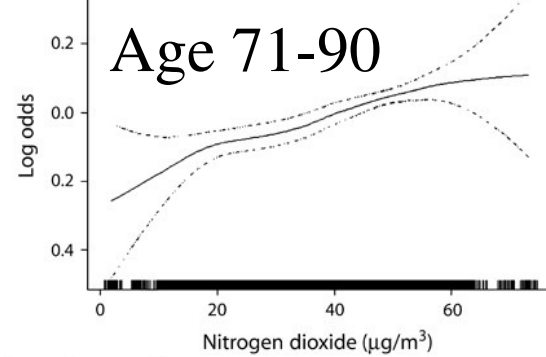
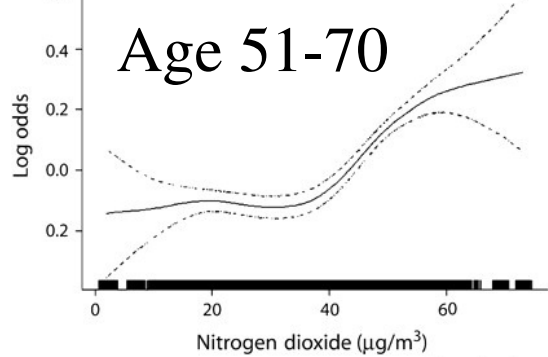
Significant for males & females  
for cardiovascular, respiratory  
and total mortality, at lag 0-1,  
0-7 and 0-14. Cumulation of  
latent effects exceeds harvesting



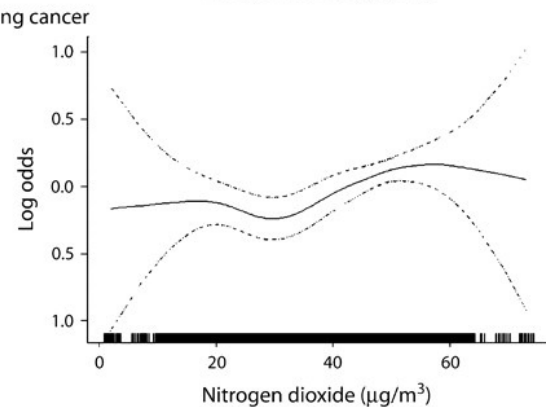
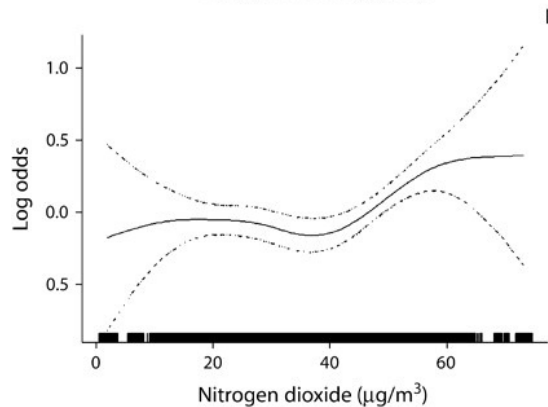
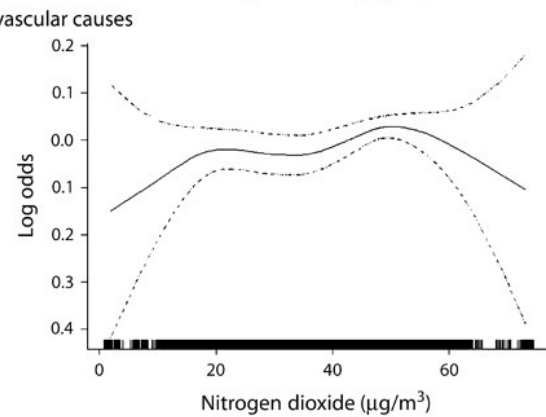
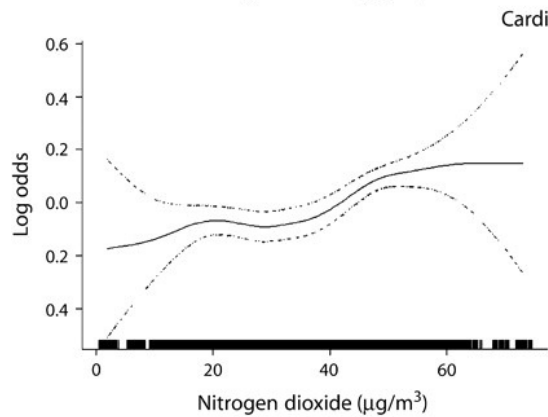
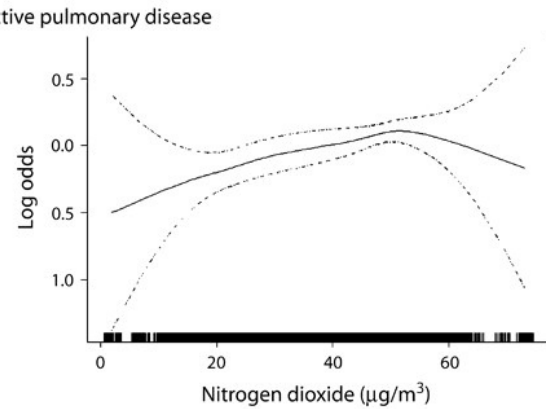
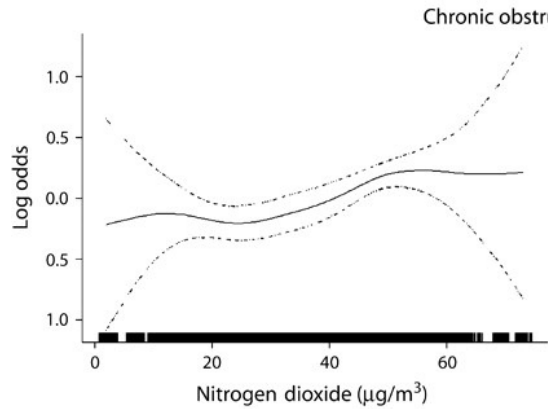
No significant effect of ozone

← adjusted for meteorology  
and influenza (recorded  
by sentinels)

particle effects: no threshold  
threshold for NO2 < 30  $\mu\text{g}/\text{m}^3$



Age-adjusted, nonparametric smoothed relation  
between **NO<sub>2</sub>** and mortality in Oslo from  
**all causes**

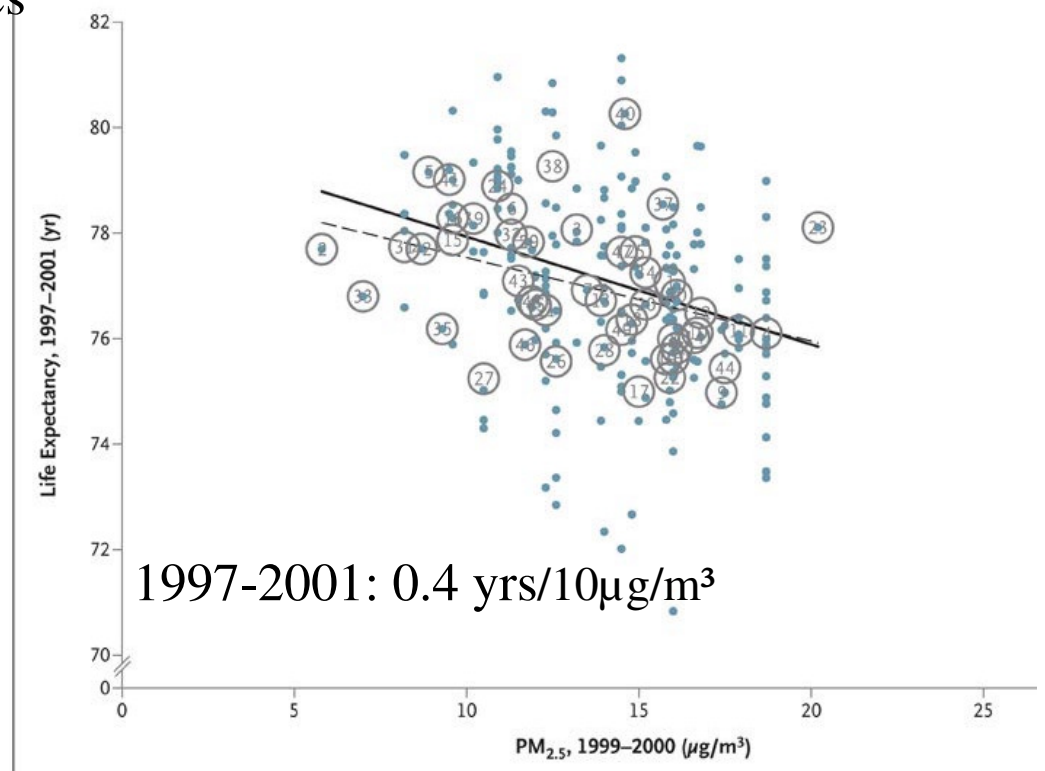
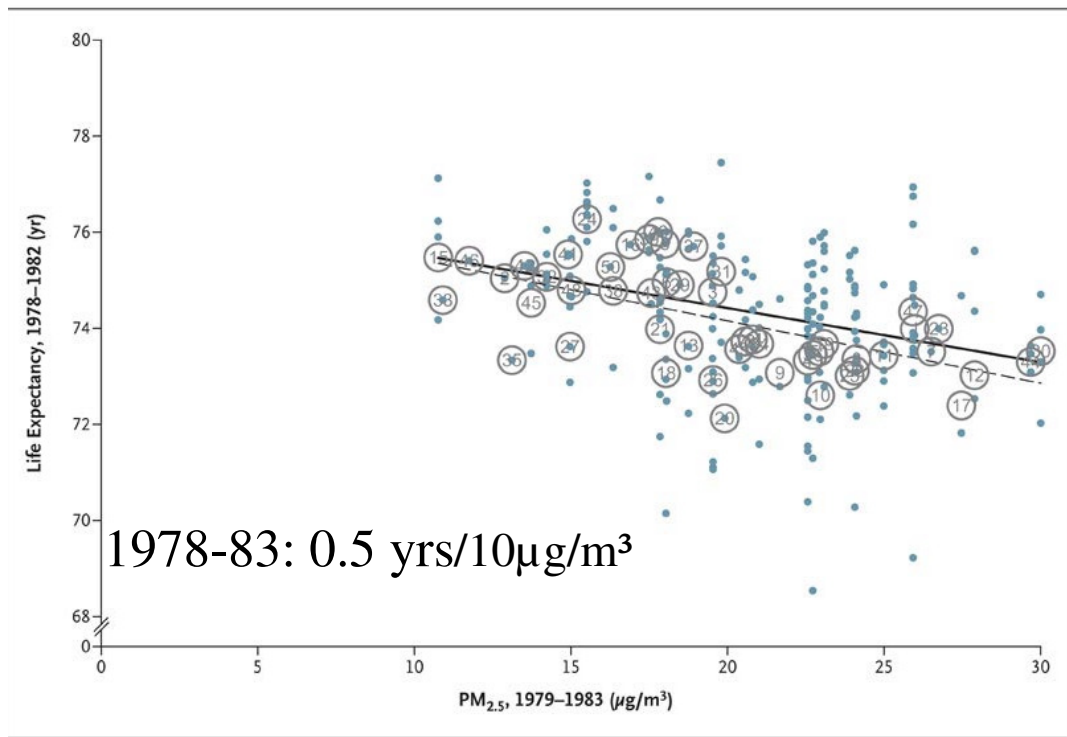


COPD

cardiovascular causes

lung cancer

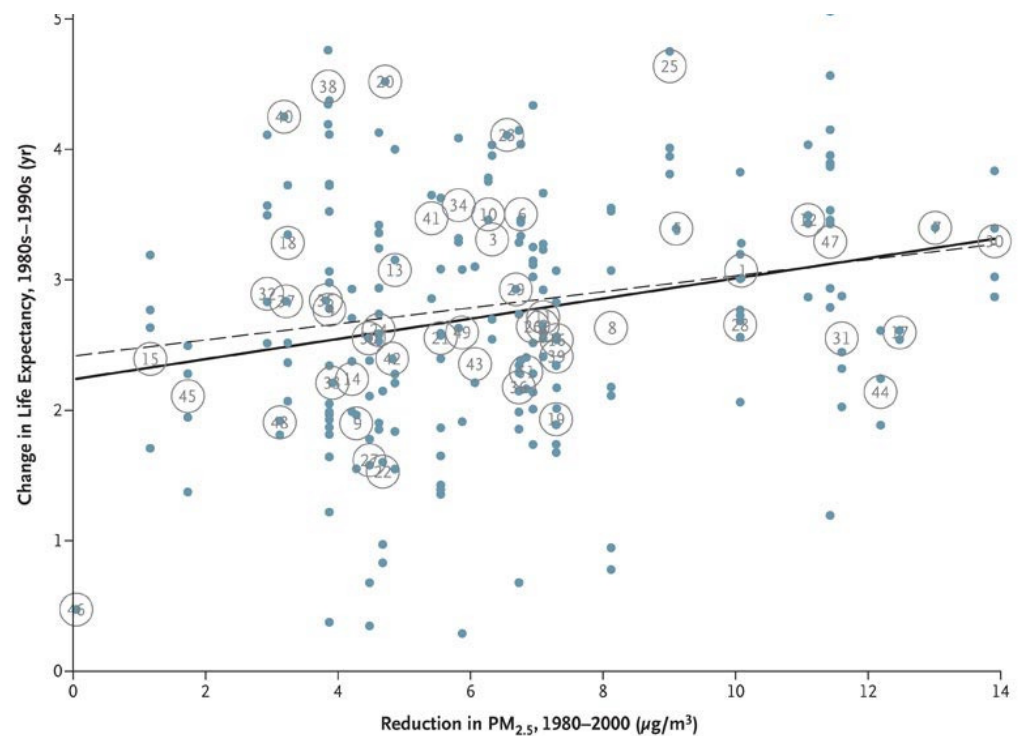
# Life expectancy & PM<sub>2.5</sub> in 51 U.S. counties



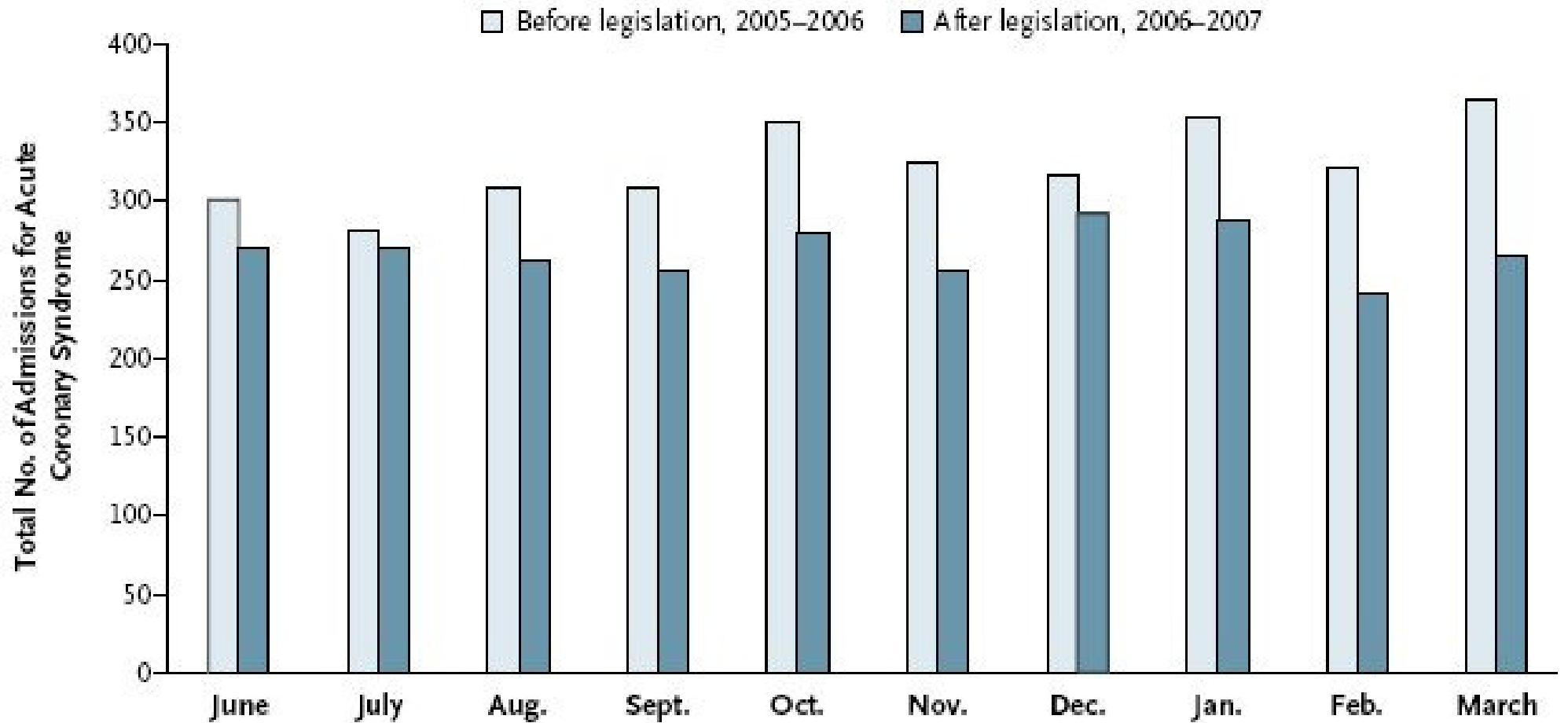
adjusted for population size, inflation corr. income, high school graduates, urban residents, migration, cumulative tobacco exposure estimated from rates of lung cancer & COPD and smoking prevalence 1978-80 in 24 areas and 1998-2002 in 50 areas.

Gain of life expectancy: **0.6 years/ $10\mu\text{g}/\text{m}^3$**

**15%** of overall increase related to **PM2.5**



Scotland: Acute Coronary Syndrome, not admitted: 6% reduction after ban  
 admitted to hospital: 17% reduction (3235 to 2684)



Pell 2008 N Engl J Med;359:482-91

admitted nonsmokers -21%  
 former smokers -19%  
 smokers -14%

Similar results on IHD and myoc. infarction  
 Ireland (Cronin 07), New York (Juster 07)  
 Piedmont (Barone-Adesi 07), Rome (Cesaroni 07)  
 Helena, Montana (Sargent 04), Pueblo, Colorado  
 (Bartecchi 06), Bowling Green, Ohio (Khuder 07)  
 Largest reduction in younger persons (more  
 frequently in bars, discos, pubs, etc)